Dominion Water & Sanitation District
9250 E. Costilla Avenue, Suite 210
Greenwood Village, CO 80112

June 30, 2018

Mr. Kevin Reidy
Colorado Water Conservation Board
1313 Sherman Street, Suite 721
Denver, Colorado 80203

Ms. Tracy Kosloff
Colorado Division of Water Resources
1313 Sherman Street, Suite 818
Denver, Colorado 80203

Re: 2018 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report

Dear Ms. Kosloff and Mr. Reidy:

Enclosed is the eighth annual report for the Precipitation Harvesting Pilot Study submitted by Leonard Rice Engineers, Inc. on behalf of Dominion Water and Sanitation District, a wholesale water provider for Northwest Douglas County, including the Sterling Ranch Development. Dominion is committed to being a good steward of water, including finding ways to manage and optimize their resources through collaboration and innovation.

In addition to the continued natural conditions data collection efforts described in the enclosed report, Dominion and Sterling Ranch have advanced the implementation of precipitation harvesting over the past year. For example, Dominion has developed a set of storm water standards that considers precipitation harvesting in the design of all storm water ponds. This facilitates Dominion's participation early and directly in the planning and integration of raw water supply, storm water management, non-potable irrigation systems, and precipitation harvesting. By strategically partnering, planning for both long and short term, and integrating technology, Dominion is continuing to develop a reliable system for cost-effective service.

Sterling Ranch has incorporated precipitation harvesting into a park shelter at the Sterling Center. This one of a kind aesthetic structure demonstrates precipitation harvesting in action while meeting local irrigation demands and collecting data for the Pilot Program. This structure is one of many creative examples of how non-potable demands will be met while providing an amenity to the community.

In March of this project year, Dominion successfully applied for a Colorado Water Plan grant for the development of regional factors for rainwater harvesting. Colorado Division of Water Resources and Colorado Water Conservation Board and Dominion are applying this grant to clarify the current legal framework and administration requirements of future applicants. Based on sound transferrable methods, Dominion is researching and developing a guide to the regional factors for other Pilot Study applicants to

use. Over the next year, Dominion will be working toward an augmentation plan and SWSP application utilizing the legal framework, methods, and data sets resulting from the grant.

The enclosed annual report provides data that was collected in our 2017/2018 pilot study year and discusses plans for the 2018/2019 study year. The 2017/2018 data includes:

- Climate data that has continued to be collected, extending the record for the site-specific data from March 2010 to May 2018.
- Sterling Gulch monitoring and data collection continues at the surface water station located on Upper Sterling Gulch, from trail cameras that document hydrologic events in real-time, and at ground water monitoring wells.
- The third year of data collection at the new lysimeter site.

Through our continued data collection, Dominion has captured information to demonstrate the precipitation harvesting's potential as a physical and legal supply. Dominion's overall precipitation this year was below our 17.53 inches average, with a total of 13.21 inches of recorded precipitation at the Sterling Ranch climate station. The largest precipitation event recorded at the Sterling Ranch climate station this project year was a snow event that occurred on May 2nd and May 3rd, totaling 1.93 inches over 24 hours. If this same storm occurred in a fully developed Providence Village, Sterling Ranch's first neighborhood, the estimated precipitation harvested from this one event may have been as much as 40-45 acre-feet. This kind of data is critical to our ability to potentially predict supply.

We appreciate and look forward to continuing our work with the Colorado Water Conservation Board and Colorado Division of Water Resources. Thank you for your continued support and leadership in developing harvested precipitation as a viable water supply.

Dominion Water and Sanitation District

By: Mary Kay Provaznik
General Manager

cc: DWSD Board of Directors
Encl: 2018 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report

July 1, 2018

Mr. Kevin Reidy
Colorado Water Conservation Board
1313 Sherman Street, Suite 721
Denver, CO 80203

Ms. Tracy Kosloff
Colorado Division of Water Resources
1313 Sherman Street, Suite 818
Denver, CO 80203

RE: 2018 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report

Dear Mr. Reidy and Ms. Kosloff,

This is the eighth annual report addressing the Sterling Ranch Precipitation Harvesting Pilot Study to be submitted by Leonard Rice Engineers, Inc. (LRE) on behalf of Dominion Water and Sanitation District (Dominion).

Introduction

Dominion's participation in the Colorado Water Conservation Board's (CWCB) Rainwater Harvesting Pilot Project Program (Program) reflects their commitment for establishing sustainable, defensible, non-potable water supplies for Northwest Douglas County including the Sterling Ranch development. Dominion's participation is in coordination with the Sterling Ranch Community Authority Board and the developers of Sterling Ranch (Sterling Ranch). Sterling Ranch continues to work passionately towards a vision for the land that is in harmony with the area, the community, and the State, and that meets a significant need for housing and infrastructure in Douglas County, including developing a positive example of conservation and efficient resource management. During the 2017-2018 project year, Dominion continued to transition from planning and data collection to implementation of precipitation harvesting by working towards an SWSP and augmentation plan, and developing storm water standards for Sterling Ranch that consider precipitation harvesting in the design of storm water facilities throughout the site.

Current Sterling Ranch Development Activity

Development of Sterling Ranch is continuing on the fast track. In the past year, all of the water and utility infrastructure for Sterling Ranch's first neighborhood (Providence Village) have been completed including the potable and raw water systems, and new water treatment and finished water storage facilities. Temporary and permanent storm water facilities used to accommodate construction activity for Providence Village have also been completed. Approximately 150 homes have been constructed to date, with an estimated 200 to be constructed by the end of 2018. Approximately 75 homes are now occupied by residents. A commercial office building known as the

Sterling Center is nearly complete with tenants expected to occupy the office space by the end of the year. Contouring and site grading for the remainder of the filings in Providence Village is underway. With development fully underway the focus of the next year will be the continued planning and implementation of precipitation harvesting systems for commercial sites and regional storm water facilities. This will include a draft application for a temporary Substitute Water Supply Plan (SWSP).

Precipitation Harvesting Criteria and Guidelines Update

On January 26, 2016, the Colorado Water Conservation Board Members approved the updated Precipitation Harvesting Criteria and Guidelines based on provisions contained in HB 15-1016. HB 15-1016, among other provisions, directs the CWCB to establish regionally applicable factors that program sponsors can use for substitute water supply plans that specify the amount of evapotranspiration of preexisting natural vegetative cover. The updated criteria and guidelines clarify the development and use of regionally applicable factors as follows:

"Sponsors of projects in areas where Regionally Applicable Factors have been adopted by the Board may propose to use the Regionally Applicable Factor to claim an evapotranspiration credit for the preexisting vegetative cover that was made impermeable through development associated with the pilot project. The evapotranspiration credit may be used prior to the sponsor completing two years of data collection and/or the sponsor's application to the water court. Proposed use of the credit will be reviewed as a part of the State Engineer's SWSP approval process."

During the 2017-2018 project year Dominion successfully applied for a Colorado Water Plan (CWP) grant to work with the Colorado Division of Water Resources and CWCB supporting the development of regional factors using a peer reviewed methodology and site specific data from Sterling Ranch. The grant also supported the development of a legal framework for navigating the legal requirements associated with developing rainwater as a legal supply. The CWP grant is a matching grant further demonstrating Dominion's commitment to the region by providing regional factors applicable to the Dominion's service area and nearby communities.

Summary of Pilot Project Progress

Generally, the Sterling Ranch Precipitation Harvesting Pilot Study (Pilot Project) has proceeded on schedule. The variances to the Pilot Project, including the proposed schedule, are described herein. The following tasks were accomplished during the 2017-2018 monitoring season:

- Climate data collection from the Sterling Ranch Climate Station;
- Data collection from the Sterling Ranch Lysimeter;
- Surface water runoff data collection;
- Trail camera data collection of surface water runoff; and
- Manual data collection from two ground water monitoring wells.
- Natural conditions data have been compiled through the 2017-2018 project year for further analysis and water budgets supporting the development of regional factors.

- In cooperation with the State, Dominion has applied for and received a Colorado Water Plan grant to further the development of regionally applicable factors based on the provisions of HB 15-1016.
- Dominion has developed storm water standards for Sterling Ranch that require storm water facilities to consider precipitation harvesting in the design.

CWCB Program and Reporting Requirements

On March 1, 2010, Sterling Ranch provided the "Sterling Ranch Precipitation Harvesting Pilot Study Application" (Application) based on the criteria and guidelines outlined by the CWCB that were established under House Bill 09-1129. The aim of the Program is to use natural conditions data to evaluate precipitation harvesting in Colorado as a legally obtainable water supply and as a water conservation enhancement when paired with advanced outdoor water demand management.

The Application described Dominion's conceptual planning policies and requirements, including Sterling Ranch's current water conservation plan and the Pilot Project strategies to be implemented that assist in the overall precipitation harvesting design.

The Pilot Project is split into three phases; 1) Natural Conditions, 2) Experimental Precipitation Harvest Designs, and 3) New Precipitation Harvest Designs.

Annual Reporting Requirements

One of the requirements of the Program is to submit an annual progress report (Annual Report) by July 1st of every year that the Pilot Project is in operation. In accordance with Section 37-60-115(6)(a), C.R.S., the Report summarizes each component of the Pilot Project and indicates how the data and findings address Program goals. The CWCB Annual Report Requirements serve as an outline for this report and are included in **Attachment A**. The information required includes:

1. A **description of variances** from the Application including information on any data quality issues that may magnify if results are extrapolated to a larger scale project.
2. **Precipitation harvesting performance metrics**.
3. Pilot Project **implementation plan and estimated water conservation** achieved through pairing precipitation harvesting with advanced outdoor water management.
4. A **description of the climate and hydrologic data collected** to characterize the pre-existing, natural vegetation conditions.

Sterling Ranch Precipitation Harvesting Pilot Project – Progress and Variances

Four objectives were established in the Application that was designed to meet the guidelines and criteria provided by CWCB. They are:

1. Evaluate natural conditions (climate, hydrology, and ET) to quantify the amount of precipitation physically and legally available as a water supply;

2. Evaluate a variety of precipitation collection designs;
3. Evaluate precipitation harvesting paired with advanced outdoor water demand management as a water conservation practice; and
4. Create a baseline set of data to support:
    a) An engineering report in support of a water court application for an augmentation plan to use harvested precipitation, and define a defensible water supply.
    b) Develop sound, transferable, and scalable methodologies for use at other locations in the State of Colorado.

Phase 1 of the Pilot Project began with the installation of the measuring devices in 2010 and have been collecting natural conditions data ever since. Now with Sterling Ranch development under way, Dominion is focused on the final planning and implementation of Phase 2 and 3 of the Pilot Project and the development of a regional precipitation harvesting system. These efforts are further discussed in the sections below.

Phase 1: Natural Conditions

The Sterling Gulch watershed is the study basin selected to evaluate natural conditions at Sterling Ranch. A comprehensive monitoring plan has been implemented in Sterling Gulch to collect climate, precipitation, surface runoff, native ET, deep percolation, and ground water data providing the foundation for defining physical yield characteristics and return flow obligations under natural conditions.

Figure 1 shows the location of the Sterling Gulch watershed and the location of the implemented monitoring stations within the Sterling Ranch boundary to date. Sterling Gulch is being used to quantify the site-specific amount of precipitation that, under pre-existing natural vegetation conditions, accrues to the natural stream system via surface and ground water return flows. The sections below summarize the progress, variation, and data collected to date for each of the monitoring programs designed to characterize the natural hydrology at the site.

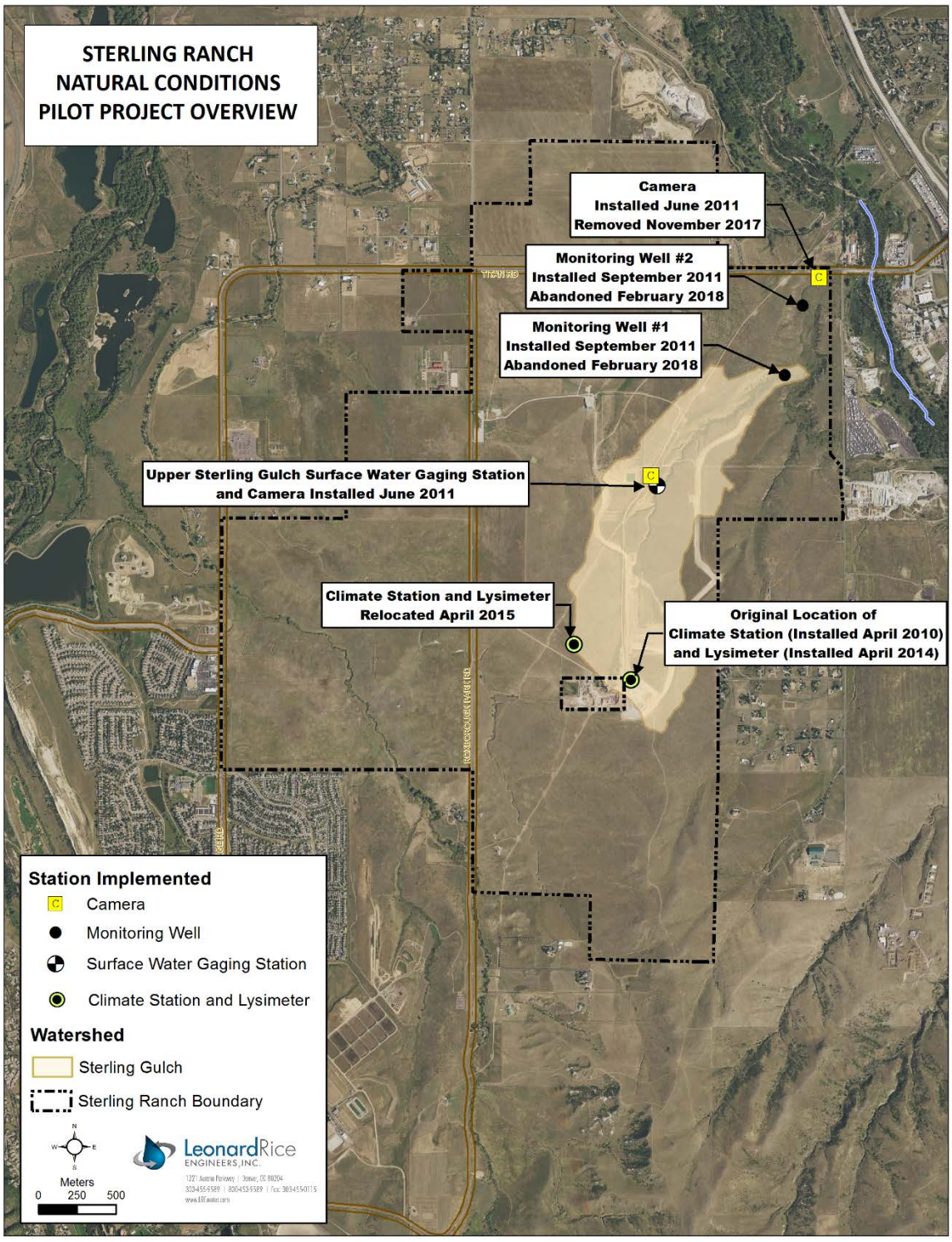

Figure 1 – Sterling Gulch Basin Map

Climate Monitoring Program

2017-2018 Variance from Application: None

The Sterling Ranch Climate Station was installed on March 29, 2010 and moved to new location in April 2015 (see **Figure 1 & Figure 2**). The station continues to collect data that is used to characterize local weather patterns, and will be used for the future estimates of native ET. The data collected at the Sterling Ranch site includes net solar radiation, air temperature, wind velocity and direction, relative humidity, and barometric pressure, and soil temperature at varying depths. Most data is recorded in 15-minute intervals, transmitted to the Sterling Ranch website, and archived in a centralized database. **Table 1** is a monthly summary of the data collected to date from the Sterling Ranch Climate Station. The original soil temperature sensors at the climate station have been discontinued, with this information being replaced by data recorded at each of the soil moisture sensors associated with the lysimeter.

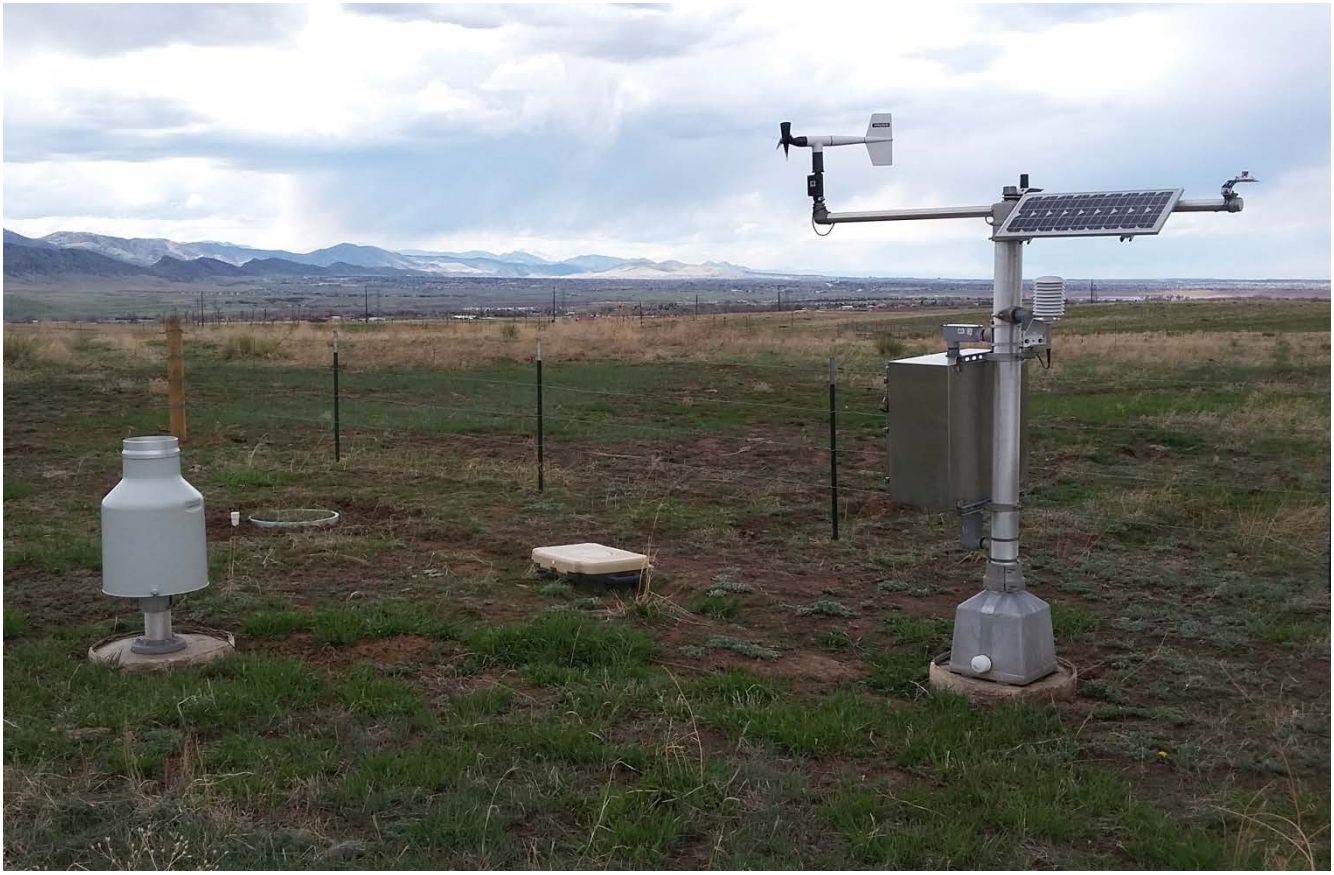

Figure 2 – Sterling Ranch Climate Station (April 2016)

Table 1 – Sterling Ranch Climate Station Monthly Summary

Year	2017							2018				
Month	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**
Temperature (F)												
Average Temperature	69.4	73.9	69.4	63.9	50.0	46.3	35.2	37.1	31.8	43.4	51.0	60.9
Max Temperature	96.4	96.8	91.5	94.1	84.5	77.6	68.0	70.8	66.7	71.7	79.2	91.0
Min Temperature	45.3	55.4	50.5	39.5	22.9	23.9	-0.9	1.5	-1.5	17.4	23.9	32.5
Temp Range	51.1	41.4	41.0	54.6	61.6	53.7	68.9	69.3	68.2	54.3	55.3	58.5
Wind (mph)												
Average Velocity	6.1	6.5	6.2	6.3	6.3	6.1	6.1	6.4	5.9	7.2	7.6	6.8
Max Velocity	46.0	34.8	31.3	28.0	33.7	36.5	33.3	27.9	34.7	48.2	44.0	32.0
Solar Radiation (MJ/m2 h)												
Average Radiation*	1.55	0.96	1.05	0.98	3.00	2.97	2.57	-	-	-	-	-
Max Radiation*	5.43	4.21	4.96	4.57	5.81	5.82	5.83	-	-	-	-	-
Barometric Pressure (mbar)												
Average BP	822.93	827.12	826.41	824.15	823.53	821.93	822.99	822.95	818.86	819.43	820.19	821.82
Max BP	832.24	832.47	864.76	833.81	837.49	831.20	834.33	834.75	829.05	829.58	833.78	831.37
Min BP	811.12	821.46	817.75	808.80	807.73	807.51	807.94	803.77	803.94	805.16	802.63	812.01
Humidity (%)												
Average Humidity	41.7	43.3	47.6	47.8	47.2	47.1	44.1	40.1	56.2	40.9	44.4	51.7
Max Humidity	95.2	97.0	97.6	98.3	98.7	98.1	96.8	97.5	96.7	99.3	98.9	99.4
Min Humidity	6.9	7.8	9.5	4.3	5.4	5.0	3.5	7.0	6.4	4.0	6.1	4.0

* Net radiation sensor failed in January 2018. The net radiation data recorded at the Sterling Ranch Climate Station during the 2017-2018 project year is provisional until further investigation can be completed.

Precipitation Monitoring Program

2017-2018 Variance from Application: None

Figure 3 – OTT Pluvio^2

An OTT Pluvio^2 weighing precipitation gage was installed on the site and began collecting data on March 29, 2010 (see **Figure 3**). The precipitation gage is located at the Sterling Ranch Climate Station and reports data in 15-minute intervals. The data collected at the site includes total accumulation and maximum rainfall intensity. The physical measurement of precipitation is important in characterizing the native water supply, native water demand, and other hydrologic processes. **Table 2** is a summary of the data collected from the Sterling Ranch precipitation station. During the 2017-2018 monitoring season there was a total of 13.21 inches of precipitation accumulated with the max intensity rate of 4.83 in/hr occurring on October 9th, 2017.

Table 2 – Sterling Ranch Precipitation Station Summary

Year	2017							2018				
Month	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Precipitation (in)												
Monthly Total	0.45	1.56	1.59	1.64	1.34	0.61	0.36	0.39	0.57	0.98	1.19	2.53
Max Intensity (in/hr)	1.06	1.91	2.38	3.08	4.83	0.43	0.43	0.27	0.38	0.42*	0.60	1.34

* A snow event on March 19th resulted in an errant max intensity of 20.47 in/hr

Surface Water Monitoring Program

2017-2018 Variance from Application: None

The surface water monitoring program was continued during the 2017-2018 monitoring season to quantify the site-specific stream flow that accrues to the natural stream system through surface water flows. Trail cameras have been installed to document surface water events in real-time at the surface monitoring sites within the Sterling Gulch basin.

Figure 1 shows the location of the Upper Sterling Gulch surface water station completed in June 2011 and the location of trail camera used to document surface water events. This surface water station includes a 9-inch Parshall Flume, shaft encoder water level sensor, and data logger.

Recorded Surface Water Events

Figure 4 is the hydrograph for the 2017-2018 project year. There were zero observed events with greater than 0.10 cfs average discharge recorded at the Upper Sterling Gulch flume during the 2017-2018 project year. Note the Upper Sterling Gulch flume is not maintained from November 1st to March 1st, but data is collected. During this period data was unavailable from November 2, 2017 through December 11, 2017 due to a loss of digital data.

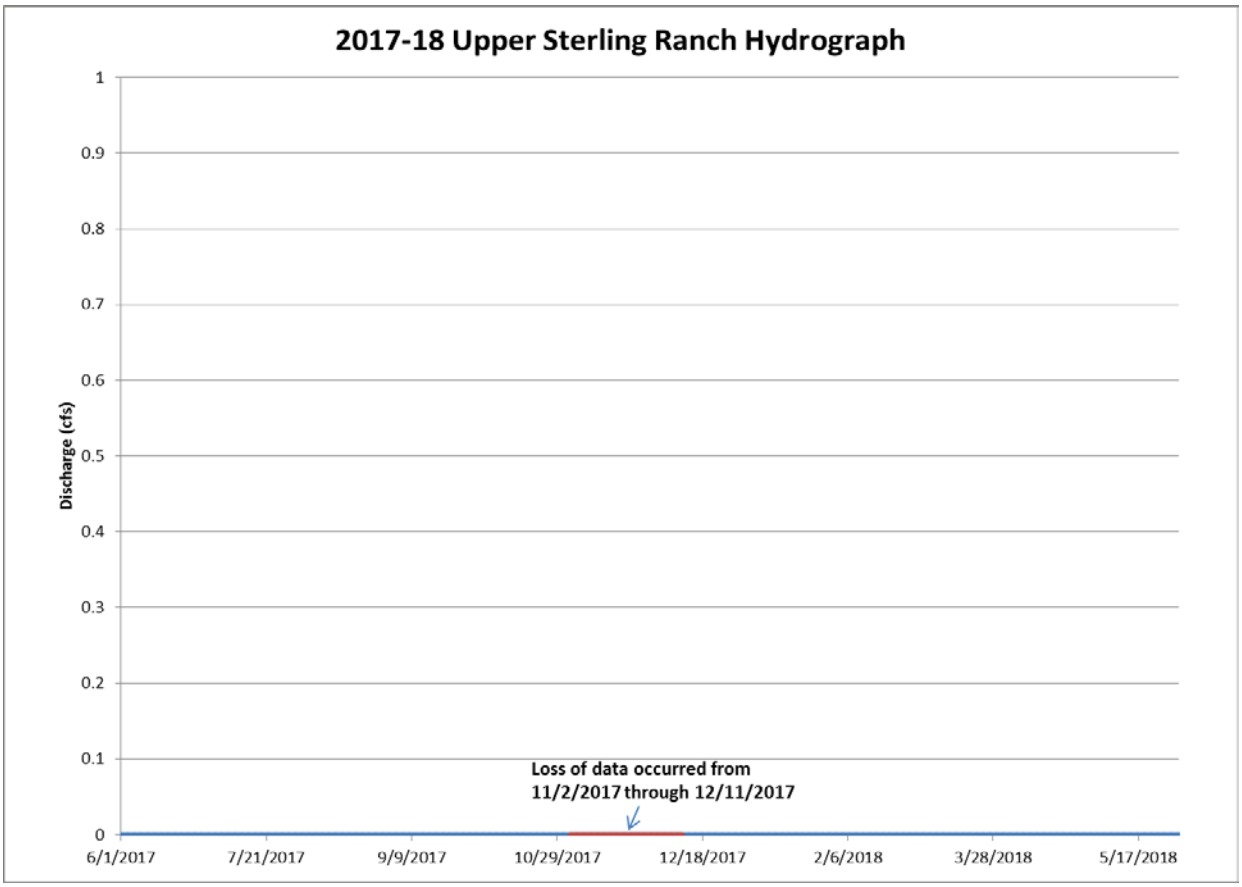

Figure 4 – 2017-2018 Upper Sterling Gulch Hydrograph

Only the trail camera at the Upper Sterling Gulch flume was active for the 2017-2018 project year. The trail camera at the culverts at Titan Road was removed on November 2, 2017 due to construction concerns in the area. The trail cameras at both locations are programed to capture photos every fifteen minutes day and night.

Native Vegetation (ET) Monitoring Program

2017-2018 Variance from Application: None

The design and construction of a single weighing lysimeter began in January 2014. A representative single intact soil core was collected on April 8, 2014 in an area of Providence Village where future precipitation harvesting is planned. The lysimeter was completed and began transmitting data on April 11, 2014. The lysimeter is 24 inches in diameter, 42 inches tall and is equipped with three 500 lb load cells, 4 soil moisture sensors, and a tensiometer controlled vacuum system and tipping bucket. The lysimeter was constructed next to the climate station to take advantage of the existing sensors and telemetry infrastructure at the site. In April 2015 the lysimeter was moved along with the climate station to a new location. At that time the lysimeter load cells were recalibrated and the soil moisture sensors and vacuum system were tested.

The data collected at the lysimeter will be used to address two important aspects of the pilot study; the actual native vegetation ET and the amount of precipitation that percolates through the soil root zone to the ground water table known as ground water recharge or deep percolation. The lysimeter may also provide some insight on site-specific soil moisture storage and surface runoff. The 2017-2018 project year was the third year of data collection at the lysimeter. Lysimeter data collected during the 2017-2018 monitoring season is still under review and was not compiled for this report.

Ground Water Monitoring Program

2017-2018 Variance from Application: None

Understanding pre-existing ground water interactions on Sterling Ranch is another important component of the water budget. Quantifying the amount, timing, and location of ground water return flows that accrue to the local alluvial aquifer from precipitation events is important when determining augmentation requirements to local streams. The installation of two monitoring wells located within Sterling Gulch was completed in September 2011 (see **Figure 1**). **Table 4** below summarizes the manual ground water level data collected at each of the monitoring wells with an M-scope.

Table 3 – Sterling Gulch Monitoring Well Recorded Depth to Ground Water

Date	Depth (ft)	2017**					
		6/9/17	7/10/17	8/4/17	9/8/17	10/20/17	11/2/17
Recorded Depth of Ground Water (ft)							
MW-1	15.30	Dry	Dry	Dry	Dry	Dry	Dry
MW-2	17.96	Wet*	Wet*	Wet*	Wet*	Wet*	Wet*

*Some condensation/dampness at the bottom of well

**No 2018 measurements (wells abandoned on 2/21/18)

During the 2017-2018 project year only manual water levels measurements were taken. All manual observations completed at both MW-1 and MW-2 detected no measurable alluvial ground water levels. The bottom of MW-2 indicated some condensation or dampness.

On February 21, 2018 both MW-1 and MW-2 were abandoned and plugged based on Colorado Division of Water Resources protocols. Drainage improvements and grading occurring in this area of Sterling Gulch required the wells to be abandoned.

Monitoring Program Maintenance Plan

Since March 2010, OneRain has been the contractor assisting in the monitoring and maintenance of the Sterling Ranch climate station. The design of the monitoring plan is modular, and the maintenance requirement of each monitoring program element is different. Once installed, routine physical inspections of all instrumentation were conducted. Real-time sensors were remotely monitored to verify that they are operating correctly. The data-logging sensors were checked and maintained every time that the data was retrieved. During the compilation of the data for this report it was observed that the net solar radiation sensor began recording errant data beginning January 2018. As a result the sensor is scheduled to be replaced in July 2018.

Beginning in July 2011, Leonard Rice Engineers, Inc. has been responsible for the data collection and maintenance of the Upper Sterling Gulch flume, trail cameras, and monitoring wells. The site has been visited a total of eight times over the 2017-2018 monitoring season with maintenance and data collection occurring each time. During the 2017-2018 project year, data was recovered from all sensors and cameras during the March through October monitoring season. Flume data reports were reviewed and found to be reliable, with no major outliers resulting from measurement and program errors. At each of the monitoring wells, water level data was collected manually using an M-scope. Data collected at the monitoring wells were then reviewed for consistency. Note that the monitoring well program was discontinued as a result of the wells being abandoned and plugged on February 21, 2018.

Natural Consumptive Use, Return Flows to the River, Water Budgets, and Models

As a result of the Colorado Water Plan (CWP) grant funding, significant progress has been made during the 2017-2018 project year in the development of water budgets and supporting models used to quantify the natural surface and groundwater return flows, and consumptive use. These models and methods are the basis for the development of both site specific factors representative of Sterling Ranch and the Dominion service area as well as regional factors that will benefit the community. Water budgets, models, and methods will be summarized in the final report submitted upon conclusion of the CWP grant.

Phase 2: Experimental Precipitation Harvesting Designs

Experimental precipitation harvesting designs is an ongoing planning and implementation effort that evaluates the feasibility of residential, commercial, and regional harvesting designs at the development. Dominion and Sterling Ranch continue to evaluate and collect information about different types of precipitation harvesting designs, equipment, and materials. The information collected under this phase of the project will be applied to new designs.

During the 2017-2018 project year Sterling Ranch incorporated a precipitation harvesting park shelter (**see Figure 6**) as a part of the new Sterling Center located in the northwest corner of Providence Village near Titan road. The shelter is currently in the construction phase and to be completed in July 2018. Rainwater from the structure will be measured then directed to irrigate the immediate landscape. Information gathered from the shelter may include total precipitation harvested and capture efficiencies for different storm types.

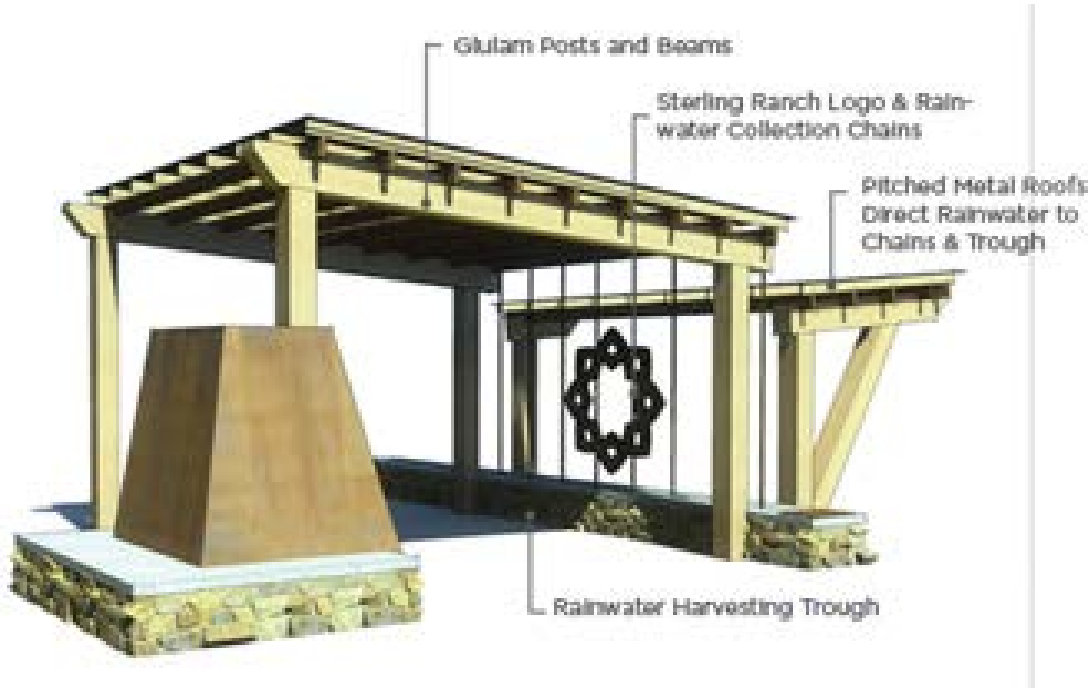

Figure 6 – Precipitation Harvesting Park Shelter

Phase 3: New Precipitation Harvesting Designs

Dominion continues to focus on targeted and regional precipitation harvesting opportunities as the most cost effective solutions. **Figure 7** is a map of the Sterling Ranch planned community and villages. At this time there are two primary opportunities being evaluated where new precipitation harvesting designs are planned.

Providence Village

The first opportunity to evaluate new precipitation harvesting designs on a regional scale is Providence Village. Providence Village, located in the northeast corner of the development adjacent to Titan Road and Sterling Gulch, is the location where the most significant development has taken place. Currently, over 150 homes have been built or are under construction and major utility and transportation corridors are complete, including multiple permanent and temporary storm water facilities. With increasing impervious surface area every day, Providence Village will be the first location where regional collection to centralized storage will be utilized to monitor and harvest precipitation for non-potable use. Several storm water facilities have been identified as potential capture locations and are in the planning phase for retrofit.

Also within Providence Village is the first commercial site known as the Sterling Center, which includes the precipitation harvesting park shelter described above. The Sterling Center is the first location where targeted precipitation harvesting may be used to meet local non-potable demands.

Prospect Village

The second opportunity to evaluate new precipitation harvesting designs on a regional scale is Prospect Village. Prospect Village is located in the southwest corner of the development adjacent to Rampart Range Road and Willow Creek and is the next location where development is planned to take place.

The planning and integration of raw water supply, storm water management, non-potable irrigation systems, and precipitation harvesting has been an important focus of the past year and has resulted in a set of comprehensive storm water standards. Dominion has developed these storm water standards to facilitate the consideration of precipitation harvesting during the design phase of the project. Considerations include: sizing of facilities and pumps, monitoring requirements, connections to the non-potable system, and easement/access for maintenance of these facilities. Over the next year Dominion will be working with storm water engineers to evaluate storm water facility designs prior to construction.

Although several opportunities have been identified there is no data to report on New Precipitation Harvesting Designs for the 2017-2018 project year.

Figure 7 – Sterling Ranch Village Map

Overall Pilot Project Schedule

With construction and home building under way the pilot program is on schedule and continues to progress. Below is a summary of the variances from the original application:

2017-2018 Variance from Application:

- Climate and precipitation monitoring site was installed in March of 2010 and is collecting data. *On Schedule*
- The lysimeter was installed in April 2014 and ET and deep percolation monitoring has begun. *Delay = approx. 3 years (Same as last year)*
- The first surface water monitoring site was installed in June 2011 and is collecting data. *Ahead of schedule = 6 months (Same as last year)*
- Ground water monitoring started in September 2011. *Ahead of schedule = 1 year (same as last year)*
- All planning and implementation of Experimental Harvesting Designs continues to progress as the project progresses. (*Delayed an additional 1.5 years)*
    - Residential Experimental Site - *Delay = approx. 6.0 years*
    - Commercial Experimental Monitoring Site - *Delay = approx. 6.0 years*
    - Regional Observation Site - *Delay = approx. 6.0 years*
- All New Precipitation Harvesting Designs are planned to begin within the next year. *(Same as last year)*
    - Residential System - Delay = approx. 5 years
    - Commercial System – Delay = approx. 4.5 years
    - Regional System – Delay = approx. 4 years
- We are in our third year developing a plan for administering precipitation harvesting, which continues to evolve to incorporate the new information from the Regional Factors CWP grant into the plan. Datasets supporting an SWSP and augmentation plan have been compiled and are being analyzed. A draft SWSP and augmentation plan application is planned to be completed within the next year - *Delay = approx. 5.5 years (Same as last year)*

Figure 8 shows the proposed timeline with the adjustments made due to the extended schedule as described above. As shown, the climate and precipitation monitoring programs were implemented and began monitoring in 2010. In 2017-2018 project year the natural conditions data collection has resumed with the continuation of lysimeter and ET monitoring. Experimental precipitation harvesting designs is an ongoing planning and implementation effort that evaluates the feasibility of residential, commercial, and regional harvesting designs at the development. New construction and implementation of planned precipitation harvesting designs began during the 2017-2018 project year with the focus on storm water standards for individual and regional facilities as well as targeted opportunities. Administration and monitoring is expected to begin this year.

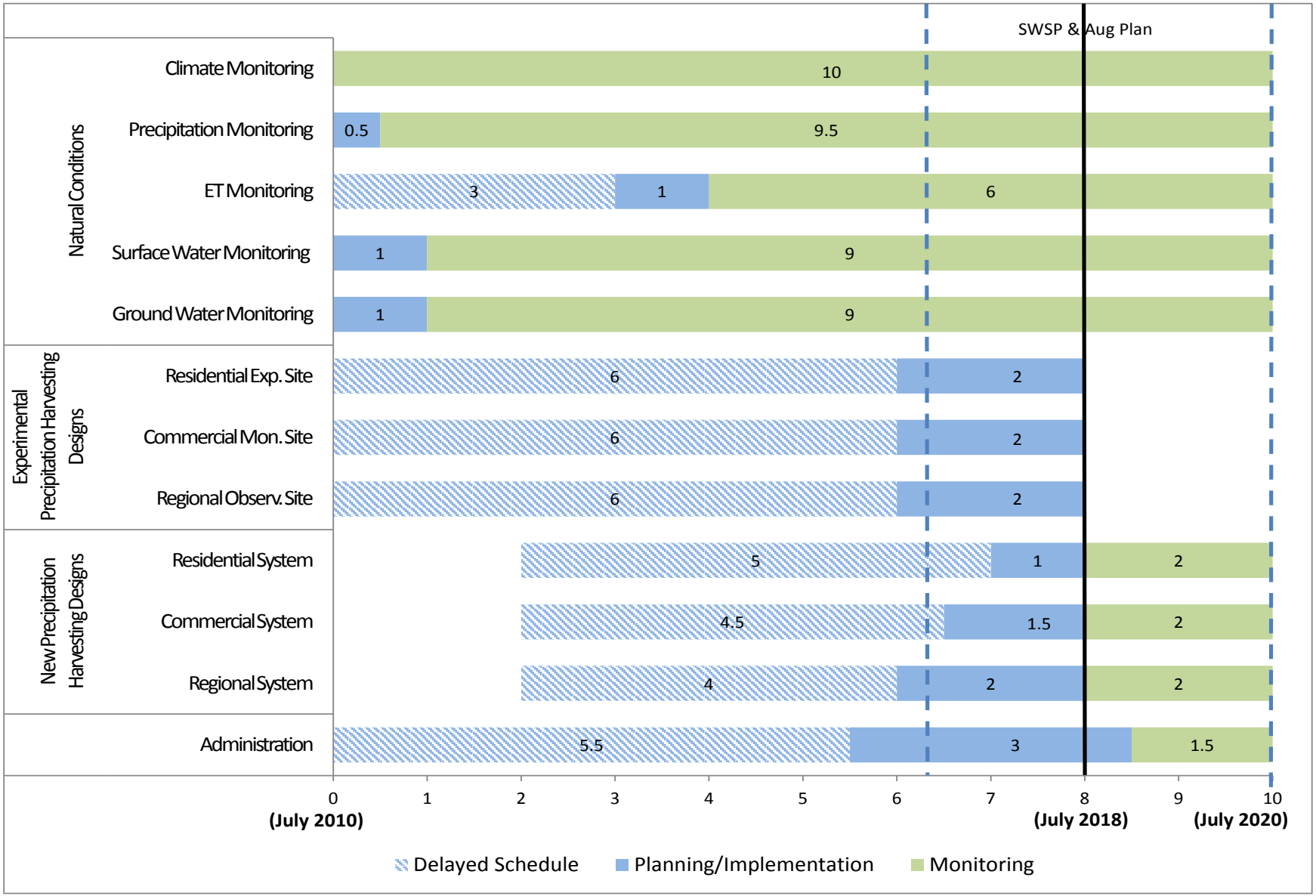

Figure 8 – Updated Pilot Project Schedule

Augmentation Requirements

Currently, there is no precipitation harvesting on Sterling Ranch. Therefore, no augmentation is required at this time. Over the next year, Dominion will be working toward an augmentation plan and SWSP application utilizing the legal framework, methods, and data sets resulting from the CWP grant.

Implementation

As described in the New Precipitation Harvesting Designs section above, several precipitation harvesting opportunities have been identified. However, data is not yet available for describing operation and maintenance of regional or targeted precipitation harvesting facilities.

Estimated Water Savings, Landscape Plans, Metered Water Use, Consumptive Use and Estimated Water Conservation, and Estimated Unit Cost for Rainwater

With over 75 homes occupied, the 2017-2018 project year was the first year metered water use data was collected at Sterling Ranch. Each home is equipped with a dual-water metering system that provides real-time data on how much water is used at individual lots for outdoor use, and how much is used for indoor use. In addition WaterSense certified irrigation controllers are standard for every home, informing residents when their outdoor water usage exceeds recommended levels for landscaping maintenance. Although the metered water use data has been collected, it is still being compiled and reviewed. With no precipitation harvesting currently occurring onsite, this data will provide a baseline for understanding indoor and outdoor water use with exiting fixtures and water conservation practices. Going forward this baseline will help establish estimated water conservation and unit cost associated with rainwater.

Sterling Ranch continues to target the average irrigated area for single family detached homes to 1,500 sq ft and encourages residents to develop their landscapes to include WaterWise plantings from an approved plant list developed in cooperation with Denver Botanical Gardens. With the majority of landscapes being established, higher than normal outdoor water use is anticipated the first year.

Over the next year, Sterling Ranch and Dominion will continue to collect and compile metered water use that can be used to estimate consumptive use, water conservation, and unit costs for precipitation harvesting.

Costs to date

Below is a summary of the primary costs associated with the Pilot Project for the 2017-2018 project year including: climate and lysimeter monitoring, natural conditions monitoring, data management an analysis, regional factor development, and rainwater implementation.

- Climate Station and Lysimeter Monitoring – $3,577

- Natural Conditions Monitoring and Maintenance – $6,768
- Data Management/Analysis/Reporting – $7,003
- Regional Factor Development (CWP Grant) - $11,898
- Rainwater Implementation - $11,647

Partnerships and the Sharing of Information

As interest and participation in precipitation harvesting and rain barrels increases, the public perception and acceptance that rainwater has the potential to be an important and viable water supply for Colorado's future has also increased. Sterling Ranch and Dominion continue to look for opportunities to engage the water community and to educate them about the Sterling Ranch Pilot Program as well as the importance of pairing precipitation harvesting with water conservation practices.

Dominion's presentation at the Special District Association annual conference in September is one example of our recent efforts to engage the public and share information about precipitation harvesting during the 2017-2018 project year. The presentation provided an overview of precipitation harvesting and included an update on current legal framework, associated costs, and how an entity can get started with precipitation harvesting. Since that time, Dominion has had several inquiries and meetings with interested parties about the Pilot Program and the viability of precipitation harvesting as a legal water supply.

Dominion has continued their partnership with the State to support the development of regional factors, further incentivizing additional Pilot Programs. The CWP Grant accelerated the development and evaluation of methods for determining regional factors as well as the legal framework for the administration of precipitation harvesting as a viable and legal water supply. We recognize the importance of this partnership and look forward to advancing precipitation harvesting together.

Closing

This letter report describes the eighth year of the Sterling Ranch Precipitation Harvesting Pilot Study. If you have any questions, please feel free to call at 303-455-9589.

Sincerely,

LEONARD RICE ENGINEERS, INC.

Mark Mitisek, P.H.
Project Manager

Greg Roush, P.E.
Chief Operating Officer

Sterling Ranch, Attachment A - CWCB Requirements for Annual Report

1. A description of variances from the Pilot Project application including information on any data quality issues that may magnify if results are extrapolated to a larger scale project.

2. Precipitation harvesting performance metrics, including:
    a) Description of final collection system design with plans and specifications of all system components.
    b) Operation and maintenance plans and any issues encountered.
    c) Meter data of water flowing into the precipitation collection device and estimated capture efficiency.

3. Pilot project implementation plan and estimated water conservation achieved through pairing precipitation harvesting with advanced outdoor water management, including:
    a) A description of the applied method used to capture precipitation and any potable water supply with plans and specifications for all system components including any technology utilized (system programmers, ET controllers, etc.).
    b) Landscaping plans including measured irrigated acres, plan descriptions, theoretical irrigation water requirement methods, results, and water budgets reflecting application efficiencies.
    c) Metered water use from precipitation collection system. Water use will be categorized by use if application varies.
    d) Metered water use from other potable water supplies if the precipitation collection is supplemented. Water use will be categorized by use if application varies.
    e) Comparison of actual consumptive use by category of use to estimated water budgets. Estimate amount of water conserved as a result of the precipitation harvesting.
    f) A landscape maintenance assessment of quality of the landscapes, maintenance issues encountered, and any necessary replacement of plantings. The results of the irrigation system audit and corresponding actions.
    g) Cost to date including design, infrastructure, operations, and maintenance costs. Estimated costs to implement precipitation harvesting system per acre-foot of water saved; and comparison of original projected and actual costs from implementing the precipitation harvesting systems. The cost comparison will include institutional, legal, technical/design, infrastructure, and augmentation water supplies.

4. A description of the climate and hydrologic data collected to characterize the preexisting, natural vegetation conditions including:
    a) A description of the methodology and analysis results toward providing information about the technical ability to reasonably quantify the site-specific amount of precipitation that, under preexisting natural conditions, accrues to the natural stream system via surface and ground water return flows.
    b) A description of the baseline set of data and sound, transferrable methodologies used for measuring local weather and precipitation patterns that account for variations in hydrology and precipitation event intensity, frequency, and duration.
    c) Descriptions of the methodology and analysis results quantifying preexisting natural vegetation consumption; measuring precipitation return flow amounts; identifying surface versus ground water return flow splits; and identifying delayed ground water return flow timing to receiving streams.

d) Quantification of the amount of precipitation that must be augmented to prevent injury to decreed water rights.
e) Description of the location and methods used to collect climate data measurements, with a summary of data including, at a minimum, temperature and precipitation